CLAIMS:

1. A process to produce a predictive data set which can be used to predict the property of a plating solution, said process comprising:
(a) obtaining a sample set, wherein each sample comprises a plating solution of good performance;
(b) obtaining an electroanalytical response for each said sample to produce a electroanalytical response data set;
(c) obtaining a training set that comprises said sample set and corresponding said electroanalytical response data set;
(d) analyzing said training set using decomposition method coupled with discriminant analysis method to produce a discriminant parameters data set; and
(e) validating said training data set to produce said predictive data set for a predictive model.

2. A process of claim 1 wherein said property is selected from the group consisting of:
a concentration of individual component of said electroplating bath;
an amount of breakdown products accumulated in said electroplating bath;
an amount of foreign contaminants accumulated in said electroplating bath;
a temperature of said electroplating bath;
a quantity of hysteresis on recorded voltammogram;
or combinations thereof.

3. A process of claim 1, wherein said property comprises an overall plating performance.

4. A process of claim 3, wherein said overall plating performance is selected from the group consisting of:
throwing power;

brightness of the deposit;

tensile strengths of the deposit;

ductility of the deposit;

internal stress of the deposit;

solderability performance;

resistance to thermal shock;

uniformity of the deposit;

capability of uniform filling through holes;

capability of filling submicron features in a substrate surface;

and combinations thereof.

5. A process according to claim 1, wherein said plating solution is an electroplating bath.

6. A process of claim 5, wherein said electroplating bath comprises a plating bath of one or metal selected from the following group: Cu, Sn, Pb, Zn, Ni, Ag, Cd, Co, Cr, and/or their alloys.

7. A process according to claim 1, wherein said plating solution is an electroless plating bath.

8. A process of claim 7, wherein said electroless plating bath comprises an autocatalytic plating bath of one or metal selected from the following group:Cu, Sn, Pb, Ni, Ag, Au, and/or their alloys.

9. A process of claim 7, wherein said electroless plating bath comprises an immersion plating bath of one or metal selected from the following group:Cu, Sn, Pb, Ni, Ag, Au and/or their alloys.

10. A process according to claim 1, wherein said plating solution is selected from the group consisting of:

an electrowinning bath;
an electrorefining bath;
an electropolishing bath;
an electroforming bath; or
an electromicromachining bath.

11. A process of claims 10, wherein said electroplating bath comprises a plating bath of one or metal selected from the following group:Cu, Sn, Pb, Zn, Ni, Ag, Cd, Co, Cr, and/or their alloys.

12. A process of claim 1, wherein the sample set of step (a) comprises plating solutions of known concentration within specification range.

13. A process according to claim 1, wherein the sample data set of step (a) is obtained by design of experiment (DOE) routines.

14. A process according to claim 13, wherein said DOE routine is multicomponent multilevel linear orthogonal array.

15. A process according to claim 13, wherein said DOE routine is multicomponent multilevel fractional factorial.

16. A process of claim 1, wherein the sample set of step (a) comprises freshly prepared electroplating solutions of known concentration within specification range.

17. A process of claim 1, wherein said sample set of step (a) comprises industrial plating solutions with well performance (empirical sample set).

18. A process according to claim 1, wherein the electroanalytical response of step (b) is obtained by DC Voltammetry.

19. A process of claim 18, wherein the DC Voltammetry comprises DC cyclic Voltammetry.

20. A process of claim 18, wherein the DC Voltammetry comprises DC Linear Scan Voltammetry.

21. A process of claim 18, wherein the DC Voltammetry comprises DC Anodic Stripping Voltammetry.

22. A process of claim 18, wherein the DC Voltammetry comprises DC Cathodic Stripping Voltammetry.

23. A process of claim 18, wherein the DC Voltammetry comprises DC Adsorptive Stripping Voltammetry.

24. A process of claim 19, wherein the DC Voltammetry comprises DC Cyclic Voltammetric Stripping technique.

25. A process according to claim 1, wherein the electroanalytical response of step (b) is obtained by a technique selected from the group consisting of:

DC Staircase Voltammetry;

Normal Pulse Voltammetry;

Reverse Pulse Voltammetry;

Differential Pulse Voltammetry;

Square Wave Voltammetry;

AC Voltammetry;

Chronoamperometry;
Chronopotentiometry;
Electrochemical Impedance Spectroscopy technique;
Polarographic techniques;
or combinations thereof.

26. A process according to claim 1, wherein said electranalytical response of step (b) comprises a plurality of data points.

27. A process according to claim 1, wherein said electroanalytical response of step (b) is a combination of one or more portions of a complete electroanalytical response.

28. A process according to claim 1, wherein said electroanalytical response of step (b) comprises a combination of one or more portions of independent electroanalytical responses.

29. A process of claim 1, wherein said decomposition method of step (d) is selected from the group of:

Principal Component Analysis (PCA);
calculation of Mahalanobis Distance (MD);
calculation of Mahalanobis Distance with residuals (MDR);
calculation by Simple Modeling of Class Analogy (SIMCA);
calculation of F^s ratio;
internal validation;
external validation;
an combinations thereof.

30. A process to predict the property of said plating solution, said process comprising:
(a) producing a predictive data set, the predictive data set generated by:

(a1) obtaining a sample set, wherein each sample comprises an electrolyte solution of good performance;

(a2) obtaining an electroanalytical response for each said sample to produce an electroanalytical response data set;

(a3) obtaining a training set that comprises said sample set and corresponding said electroanalytical response data set;

(a4) preprocessing of said electronalytical response data set;

(a5) analyzing said training set using decomposition method coupled with discriminant analysis method to produce a discriminant parameters data set;

(a6) validating said training data set to produce said predictive data set for a predictive model; and

(b) using said predictive data set to predict the property of said plating solution, said property predicted by:

(b1) obtaining an unknown sample set, wherein each unknown sample in said unknown sample set contains a plating solution;

(b2) obtaining an electroanalytical response for each said unknown sample to produce an electroanalytical response data set;

(b3) preprocessing of said electronalytical response data set; and

(b4) applying said predictive model to predict property of each said unknown sample.

31. A process to detect faulty performance of said plating solution, said process comprising:

(a) producing a predictive data set, the predictive data set generated by:

(a1) obtaining a sample set, wherein each sample comprises an electrolyte solution of good performance;

(a2) obtaining an electroanalytical response for each said sample to produce an electroanalytical response data set;

(a3) obtaining a training set that comprises said sample set and corresponding said electroanalytical response data set;

(a4) preprocessing of said electronalytical response data set;

(a5) analyzing said training set using decomposition method coupled with discriminant analysis method to produce a discriminant parameters data set;

(a6) validating said training data set to produce said predictive data set for a predictive model; and

(a7) specifying the limits of good and faulty performance of said plating solution; and

(b) using said predictive data set to predict the property of said plating solution and qualify said solution as correct or faulty said process comprises:

(b1) obtaining an unknown sample set, wherein each unknown sample in said unknown sample set contains a plating solution;

(b2) obtaining an electroanalytical response for each said unknown sample to produce an electroanalytical response data set;

(b3) preprocessing of said electronalytical response data set;

(b4) applying said predictive model to predict property of each said unknown sample; and

(b5) qualifying said unknown samples as correct or faulty.

32. A method of monitoring performance of plating solution in order to perform controlled feed and bleed procedure, said process comprising the steps of:

(a) producing a predictive data set, the predictive data set generated by:

(a1) obtaining a sample set, wherein each sample comprises an electrolyte solution of good performance;

(a2) obtaining an electroanalytical response for each said sample to produce an electroanalytical response data set;

(a3) obtaining a training set that comprises said sample set and corresponding said electroanalytical response data set;

(a4) preprocessing of said electronalytical response data set;

(a5) analyzing said training set using decomposition method coupled with discriminant analysis method to produce a discriminant parameters data set;

(a6) validating said training data set to produce said predictive data set for a predictive model;

(a7) defining the limits of said property for said plating solution that requires feed and bleed procedure; and

(b) using said predictive data set to predict the property of said plating solution and qualify said solution as correct or faulty said process comprises:

(b1) obtaining an unknown sample set, wherein each unknown sample in said unknown sample set contains a plating solution;

(b2) obtaining an electroanalytical response for each said unknown sample to produce an electroanalytical response data set;

(b3) preprocessing of said electronalytical response data set;

(b4) applying said predictive model to predict property of each said unknown sample; and

(b5) qualifying said unknown samples as a ready or not ready solution for feed and bleed procedure.

33. A method of monitoring performance of electroplating solution in order to perform controlled purification treatment procedure, said process comprising the steps of:

(a) producing a predictive data set, the predictive data set generated by:

(a1) obtaining a sample set, wherein each sample comprises an electrolyte solution of good performance;

(a2) obtaining an electroanalytical response for each said sample to produce an electroanalytical response data set;

(a3) obtaining a training set that comprises said sample set and corresponding said electroanalytical response data set;

(a4) preprocessing of said electronalytical response data set;

(a5) analyzing said training set using decomposition method coupled with discriminant analysis method to produce a discriminant parameters data set;

(a6) validating said training data set to produce said predictive data set for a predictive model; and

(a7) defining the limits of said property for said plating solution that requires purification treatment; and

(b) using said predictive data set to predict the property of said plating solution and qualify said solution as correct or faulty said process comprises:

(b1) obtaining an unknown sample set, wherein each unknown sample in said unknown sample set contains a plating solution;

(b2) obtaining an electroanalytical response for each said unknown sample to produce an electroanalytical response data set;

(b3) preprocessing of said electronalytical response data set;

(b4) applying said predictive model to predict property of each said unknown sample; and

(b5) qualifying said unknown samples as ready or not ready for purification treatment.

34. A method of monitoring of performance of measuring system in order to detect its malfunctioning, said process comprising the steps of:

(a) producing a predictive data set, the predictive data set generated by:

(a1) obtaining a training set, wherein each sample comprises an electronic characteristic of a measurement system of good performance;

(a2) preprocessing of said training data set;

(a3) analyzing said training set using decomposition method coupled with discriminant analysis method to produce a discriminant parameters data set;

(a4) validating said training data set to produce said predictive data set for a predictive model; and

(a5) defining the limits of said property for said electronic characteristic of the well performed measurement system; and

(b) using said predictive data set to predict the malfunctioning of measurement system said process comprises:

(b1) obtaining a second data set, wherein each sample comprises an a periodically taken electronic characteristic of a measurement system ;

(b2) preprocessing of said second data set;

(b3) applying said predictive model to predict property of each sample of a second data set; and

(b4) detecting malfunctioning of measurement system by qualifying said property as a fault.